



IR spectroscopy with pyrolytic carbon string resonator as a tool for particle detection

Nguyen, Quang Long; Larsen, Peter Emil; Schmid, Silvan; Boisen, Anja; Keller, Stephan Sylvest

Publication date:
2017

Document Version
Peer reviewed version

[Link back to DTU Orbit](#)

Citation (APA):

Nguyen, Q. L., Larsen, P. E., Schmid, S., Boisen, A., & Keller, S. S. (2017). *IR spectroscopy with pyrolytic carbon string resonator as a tool for particle detection*. Abstract from 14th International Workshop on Nanomechanical Sensors, Keauhou Bay , Hawaii, United States.

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

IR spectroscopy with pyrolytic carbon string resonator as a tool for particle detection

Long Nguyen Quang¹, Peter Emil Larsen¹, Silvan Schmid², Anja Boisen¹ and Stephan Sylvest Keller¹

¹ DTU Nanotech, Denmark University of Technology, 2800 Kgs. Lyngby, Denmark.

² Institute of Sensor and Actuator Systems, Vienna University of Technology, Gusshausstraße 27-29, A-1040 Vienna, Austria

Nowadays, nanomaterials are getting a lot of research attention all around the world, especially in nanomedicine. Therefore, novel tools for their characterization are needed. Recently, Infrared (IR) spectroscopy with Silicon Nitride (SiN) string resonators [1] and membranes have been used for fast analysis of minute sample amounts. Those resonators have been exposed to IR light from a quantum cascade laser (QCL) which resulted in a change of temperature along the resonator due to photothermal heating. The resulting frequency change can be tracked to obtain the absorption spectrum of the sample.

In this work, we also use the string resonator for IR spectroscopy. However, instead of the SiN, we fabricated strings from pyrolytic carbon. There are some advantages of using the pyrolytic carbon strings: (1) the fabrication process is simple [2], (2) pyrolytic carbon is more biocompatible and (3) the carbon structure can be tailored by modifying the pyrolysis parameters. The latter leads to a different IR absorption spectrum than for SiN which makes two type of strings complimentary. Figure 1a shows the SEM image of the pyrolytic carbon strings fabricated by pyrolysis of SU-8 photoresist. The strings have a length of 400 μ m with various width from 3 μ m to 30 μ m and a thickness of 750nm. The IR absorption spectrum of the pyrolytic carbon string is shown in Figure 1b. The results show that pyrolytic carbon string shows high absorption at higher wavenumber with an absorption peak at 1760 cm^{-1} . Compared to SiN strings the absorption in this range of 800 cm^{-1} to 1600 cm^{-1} is low, which should allow to detect nanoparticles absorbing in this range if they are deposited on the top surface of the pyrolytic carbon string. Finally, Figure 1c show the Allan Deviation (AD) plot of the 15 μ m wide pyrolytic carbon string resonator with minimum AD of 10ppm at 10 seconds.

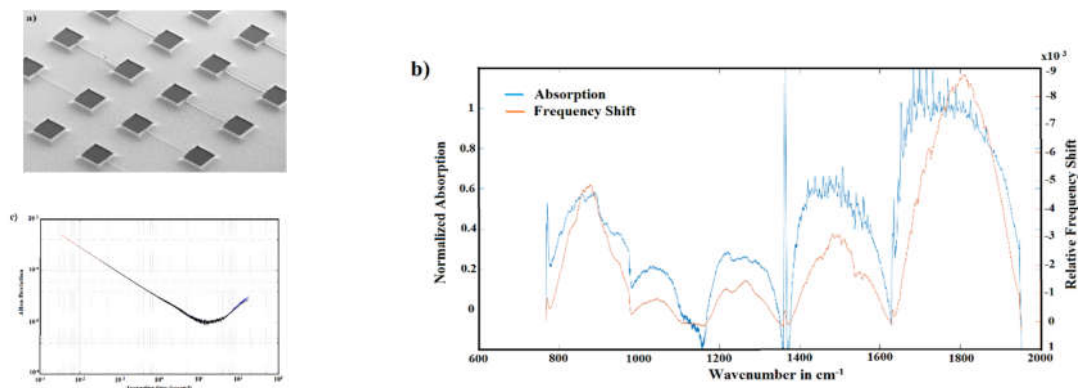


Figure 1: (a) SEM image, (b) IR absorption spectrum and (c) Allan Deviation plot of 400x15 μ m pyrolytic carbon string resonator.

[1] Andersen, A. J., et al (2016). *Nanomechanical IR spectroscopy for fast analysis of liquid-dispersed engineered nanomaterials*. Sensors and Actuators B: Chemical, 233, **667-673**.

[2] Kurek, Maksymilian, et al, *Nanomechanical Pyrolytic Carbon Resonators: Novel Fabrication Method and Characterization of Mechanical Properties*, Sensors, Vol. 16, No. 7, 2016, p. **1097**.